THE MARYLAND ENTOMOLOGIST

Insect and related-arthropod studies in the Mid-Atlantic region

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MARYLAND ENTOMOLOGICAL SOCIETY
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The Maryland Entomological Society (MES) was founded in November 1971, to promote the science of entomology in all its sub-disciplines; to provide a common meeting venue for professional and amateur entomologists residing in Maryland, the District of Columbia, and nearby areas; to issue a periodical and other publications dealing with entomology; and to facilitate the exchange of ideas and information through its meetings and publications. The MES was incorporated in April 1982 and is a 501(c)(3) non-profit, scientific organization.

The MES logo features an illustration of ***Euphydryas phaëton*** (Drury) (Lepidoptera: Nymphalidae), the Baltimore Checkerspot, with its generic name above and its specific epithet below (both in capital letters), all on a pale green field; all these are within a yellow ring double-bordered by red, bearing the message "● Maryland Entomological Society ● 1971 ●". All of this is positioned above the Shield of the State of Maryland. In 1973, the Baltimore Checkerspot was named the official insect of the State of Maryland through the efforts of many MES members.

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Editor's Note

The Maryland Entomologist is regional in scope. This year's issue features studies conducted in Maryland, Virginia, West Virginia, and the District of Columbia. This year's authors hail from six jurisdictions: one from Maine, one from Maryland, one from Oregon, one from Virginia, two from West Virginia, and two from the District of Columbia.

Frank G. Guarnieri reviewed incidental captures of *Calosoma externum* (Say) (Coleoptera: Carabidae) on Maryland's Coastal Plain during a lepidopteran monitoring and control program. **Brent W. Steury** documented the beetles (Coleoptera) associated with flowers of lizard's Tail, *Saururus cernuus* L. (Saururaceae), in Calvert County, Maryland. **Gary D. Ouellette** investigated the diversity of Sciapodinae (Diptera: Dolichopodidae) in the Greater Washington, District of Columbia area. **Mark J. Hepner** and **Ernest W. Smith** established recent records of the Yellow-banded Bumble Bee, *Bombus terricola* Kirby (Hymenoptera: Apidae), in West Virginia. **Jonathan R. Mawdsley**, **Davia M. Palmeri**, and **Mark Humpert** documented the occurrence of bumble bees, *Bombus* Latreille (Hymenoptera: Apidae), in State Wildlife Action Plans as new opportunities for conservation.

Call for Potential Authors

Dig into your field notebooks and consider publishing in *The Maryland Entomologist*. [*Don't wait till you croak; it's too late then!*] I am sure there are much data out there just waiting to be published. Put your findings in print for the world to see. Remember, your study benefits no one if you are the only person with access to it. I look forward to an inbox overflowing with submittals for the 2020 issue. Please e-mail first drafts to me by April 1, 2020. Thanks for your consideration.

Eugene J. Scarpulla
Editor

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Incidental Capture of *Calosoma externum* (Say) (Coleoptera: Carabidae) at Various Sites across the Coastal Plain of Maryland between 1988 and 1993 during a Monitoring and Control Program Targeting Lepidopteran Agricultural Pests

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Abstract: *Calosoma externum* (Say) (Coleoptera: Carabidae) is a large (24–35 mm) and attractive beetle that is not regularly encountered in the Mid-Atlantic region. Yet, *C. externum* was found in five counties on the Coastal Plain of Maryland between 1988 and 1993. The beetles were bycatch in ultraviolet light traps during an integrated pest management program targeting various species of destructive moths. Published collecting records of *C. externum* in and around Maryland are reviewed. This species may be more widespread in the Mid-Atlantic region than is currently recognized. This paper does not present enough data to make any conclusions regarding population numbers. Photographs are presented comparing *C. externum* and two similar carabid species with which it might be confused in Maryland.

Calosoma externum (Say) (Coleoptera: Carabidae) is a large (24–35 mm [0.9–1.4 in]) and attractive beetle (Figure 1). The dorsal surface is polished black. The pronotum and elytra have brilliant metallic blue or purple margins. Typically, *Calosoma* species have broad elytra that, in dorsal view, give the beetles a somewhat blocky appearance. In comparison, the elytra of *C. externum* are long and narrow. The result is an elongate and streamlined habitus, hence its common name, the Narrow Searcher. An excellent photomontage depicting all Mid-Atlantic species of *Calosoma* can be seen in Evans (2009).

Calosoma species are called searcher or caterpillar hunter beetles. Larvae and adults are well known to prey upon many insect varieties, lepidopteran larvae in particular. *Calosoma externum* has been noted to consume many agricultural pest species of Orthoptera, Coleoptera, and Lepidoptera, notably caterpillars of: *Mythimna unipuncta* (Haworth) (Lepidoptera: Noctuidae), the Armyworm; *Malacosoma americanum* (Fabricius) (Lepidoptera: Lasiocampidae), the Eastern Tent Caterpillar; and *Lymantria dispar* (Linnaeus) (Lepidoptera: Erebidae), the Gypsy Moth (Burgess and Collins 1917).

Based upon Burgess and Collins (1917), Gidaspow (1959), and Bousquet (2012), the range of *Calosoma externum* extends across eastern North America from Massachusetts to Georgia in the East, and Minnesota and Nebraska to Texas in the West. Burgess and Collins (1917) and Gidaspow (1959) report this species is more common in the "southern" part of its range. Bousquet (2012) reports that isolated records from Ontario and Vermont are probably "strays." According to Larochelle and Larivière (2003), *C.*

externum is most likely to be found in "cultivated fields, pastures, vacant lots, and open forests."

Despite three decades of field experience in the Mid-Atlantic region, I have never encountered *Calosoma externum* in the wild. Based on anecdotal reports and casual discussions with professional and avocational carabid specialists, this beetle is most likely to be found in the South-Central United States. (The type specimen described by Thomas Say in 1823 was collected in Arkansas [Burgess and Collins 1917].) Such speculation is supported by a small data set (ten records between 1972 and 2017) on BugGuide (2019). The northernmost records of *C. externum* on the website are from Indianapolis, Indiana and Lincoln, Nebraska. There are two records from Missouri and single records each from Illinois, Kansas, Kentucky, North Carolina, Oklahoma, and Texas.

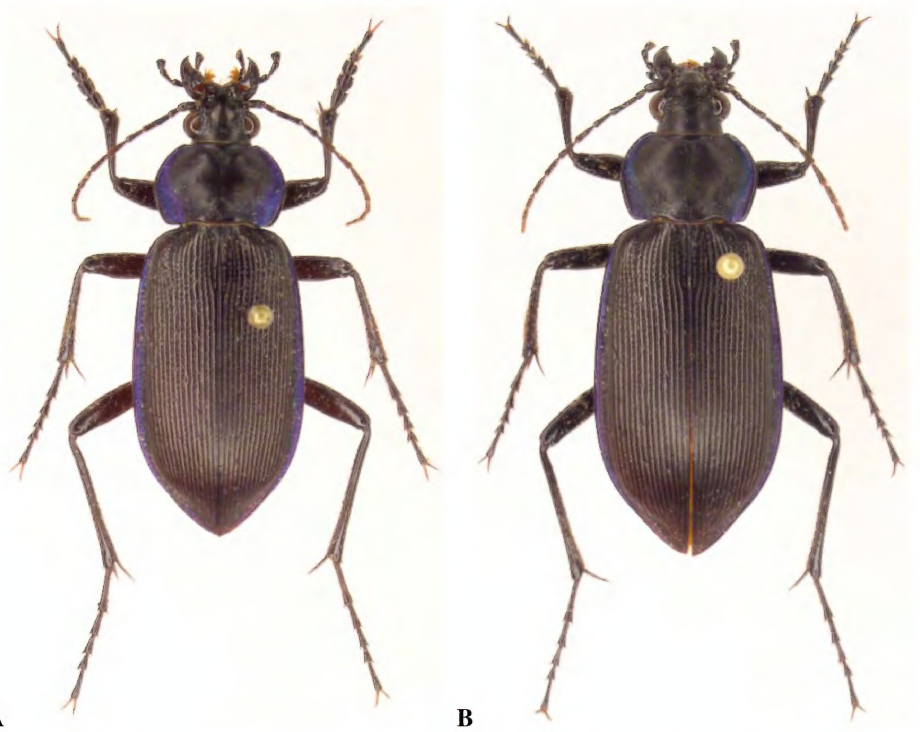


Figure 1. ***Calosoma externum*** **(Say). A) Male:** Maryland, Dorchester County, Church Creek, 15 July 1988, collected at ultraviolet light, 30 mm (1.2 in) (MDAG collection). Males have enlarged protarsal segments compared to females. The bright blue or purple margins are difficult to reproduce in photographs but can be seen fairly well in this specimen. **B) Female:** Maryland, Worcester County, Indiantown, 19 July 1993, collected at ultraviolet light, 33 mm (1.3 in) (MDAG collection).

Regarding the presence of *Calosoma externum* in and around Maryland, Burgess and Collins (1917) found eighteen specimens under electric lights in the District of Columbia between 1909 and 1912. Subsequent published records become elusive. In recent decades, many detailed surveys of carabid beetles were conducted in the District of Columbia, Maryland, southern Pennsylvania, and northern Virginia (Erwin 1981; Stork 1984; Bailey et al. 1994; Anderson et al. 1995; Evans 2008; Kim and Piechnik 2009; Guarnieri 2010; Staines and Staines 2011; Fritzler and Strazanac 2012; Steury and Messer 2014, 2015, 2017; Steury et al. 2014). Most recorded at least one *Calosoma* species, but only one survey (Steury and Messer 2017) reported *C. externum* (Calvert County, Cove Point beach, 26 September, one specimen in beach drift). Steury (in litt.) reported that the specimen was dead and missing an entire elytron. It is uncertain precisely where the specimen may have originated before floating onshore.

Recently, I encountered six Maryland specimens of *Calosoma externum* that were collected between 1988 and 1993. Four were located at the Maryland Department of Agriculture in Annapolis, Maryland (MDAG): Charles Co., Hughesville, 25 May 1993; Dorchester Co., Church Creek, 15 July 1988; Somerset Co., Princess Anne, 21 June 1988; and Worcester Co., Indiantown, 19 July 1993. Two were at the Carnegie Museum of Natural History in Pittsburgh, Pennsylvania (CMNH): Cecil Co., 12 August 1993 and Dorchester Co., Rhodesdale, 17 July 1993.

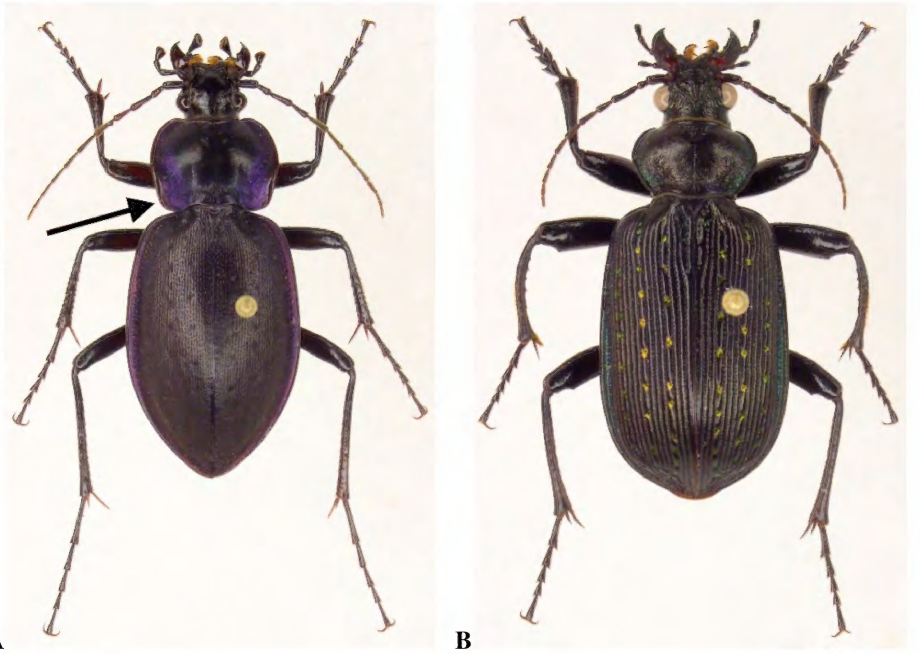
According to Gaye L. Williams (Entomologist, Plant Protection and Weed Management, MDAG) (in litt.), these six beetles were all likely long forgotten bycatch of an integrated pest management program that was started by the University of Maryland and taken over by the MDAG. The study involved numerous collaborators including the CMNH. Farmers and field scouts operated ultraviolet light traps and sent in daily catches. The samples were examined for 16 lepidopteran crop pests including: *Agrotis ipsilon* (Hufnagel) (Lepidoptera: Noctuidae), the Black Cutworm; *Helicoverpa zea* (Boddie) (Lepidoptera: Noctuidae), the Corn Earworm; and *Ostrinia nubilalis* (Hübner) (Lepidoptera: Crambidae), the European Corn Borer. Farmers used the data to coordinate control applications based on population surges of pest species.

In addition to the two Maryland specimens discussed above, the CMNH contained over 100 specimens of *Calosoma externum*. The data support the notion of a historically widespread eastern species that now appears to be most common in the South-Central United States. There are scattered records from the late 1800s and early 1900s from the District of Columbia, Maryland, Michigan, New York (restricted to Long Island), and Pennsylvania. There are two specimens from Virginia, New Kent Co., 31 December 1952. Yet, the vast majority of records, including many recently collected specimens, are from Oklahoma, Tennessee, and Texas.

The data from the MDAG survey suggest that *Calosoma externum* may be more widespread over the Coastal Plain of Maryland than is currently appreciated. But it remains unclear how these large and distinctive beetles generally go unnoticed. They may be uncommon or simply secretive. According to Robert L. Davidson (Collection Manager, Division of Invertebrate Zoology, CMNH) (in litt.), even if this species

regularly occurs in large corn and soybean fields, it could escape detection as these habitats are not typically sampled in carabid surveys.

Identification of *Calosoma externum* is fairly straightforward. However, in my experience, there are two common related species on the Coastal Plain of Maryland that might cause confusion: *Carabus sylvosus* Say (Carabidae), Woodland Ground Beetle (Figure 2A) and *Calosoma sayi* Dejean (Carabidae), Black Caterpillar Hunter, (Figure 2B).



A **B**

Figure 2. *Carabus sylvosus* Say and *Calosoma sayi* Dejean. A) *Carabus sylvosus* female: the basal angles of the pronotum are highly reflexed (black arrow) and the elytral striae are indistinct. Maryland, Worcester County, Pocomoke River State Park (38.1355°, -75.4384°), 20 July 2000, crawling on the ground in mature woods at night, 30 mm (1.2 in) (Frank G. Guarnieri collection). **B) *Calosoma sayi* male:** the elytral striae are interrupted by small metallic red, yellow, or green punctures. Maryland, Worcester County, Snow Hill (38.1879°, -75.3769°), 17 July 2000, in a parking lot at night under bright lights, 29 mm (1.1 in) (Frank G. Guarnieri collection).

Carabus sylvosus: Burgess and Collins (1917) and Ciegler (2000) also note that *Calosoma externum* and *Carabus sylvosus* are quite similar in appearance. In the latter species, the basal angles of the pronotum are more strongly reflexed and the elytral striae are indistinct. *Carabus sylvosus* is fairly easy to find running on the ground in open woods at night. The *Carabus sylvosus* specimen depicted in Figure 2A was found ~8 km (~5 mi) from the approximate location where the *Calosoma externum* specimen shown in Figure 1B was collected.

Calosoma sayi: Males, in particular, of *C. sayi* tend to have elytra that are nearly parallel-sided. The result is a thinner habitus that is closer to *C. externum* than the other members of *Calosoma* that have much wider abdomens (see the figure in Evans [2009], however, note that the *C. sayi* in the photomontage is a female specimen). *Calosoma sayi* can be identified by rows of small metallic red, yellow, or green punctures on the elytra. This species is readily attracted to light and can be abundant at night in 24-hour gas station parking lots in open agricultural areas. The *C. sayi* specimen shown in Figure 2B was found ~3 km (~2 mi) from the approximate location where the *C. externum* specimen shown in Figure 1B was collected.

To conclude, it is important to note that the Maryland records of *Calosoma externum* discussed in this report represent an extremely small data set. Thus, this paper does not present enough data to make conclusions regarding population numbers or trends. A comprehensive survey of the major regional insect collections to look for additional modern Mid-Atlantic records would be most useful. With a larger data set, it may be possible to show these beetles occur in "boom and bust" cycles, with the majority of individuals being collected in just a few years surrounded by long periods of relative scarcity. Such a pattern may, in part, explain the general paucity of observations in the field. Furthermore, it would be interesting to determine if *C. externum* numbers wax and wane in conjunction with outbreaks of particular agricultural pests or if there are any effects from pesticide applications. But for now, the intent herein is only to make readers aware of this interesting species and be vigilant to its possible occurrence, particularly in lowland agricultural fields, throughout the Mid-Atlantic region.

ACKNOWLEDGMENTS

I am indebted to Robert L. Davidson (CMNH) and Gaye L. Williams (MDAG) for very useful discussions and also for giving me access to the collections under their care. Two anonymous reviewers made most constructive comments including excellent ideas regarding possible directions of future research.

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Beetles (Coleoptera) Associated with Flowers of Lizard's Tail, *Saururus cernuus* L. (Saururaceae), in Calvert County, Maryland

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Abstract: Beetles associated with flowers of lizard's tail, *Saururus cernuus* L. (Saururaceae), are documented from a freshwater swamp in southern Maryland. Six hundred forty-six beetles representing 29 species in 14 families were documented on flowers of *S. cernuus* during eight hours of collection effort over four days in June. Mating was observed in three species of Cerambycidae, indicating a possible connection between pollen consumption and copulation. Pollen and other flower parts may be food sources for some beetles. The most common beetle on flowers of *S. cernuus* was *Isomira sericea* (Say) (Tenebrionidae). The most species-rich family was Mordellidae. Other arthropod groups observed on flowers of *S. cernuus* included: Arachnida (Araneae and Acari), Collembola, Diptera, Hemiptera, Hymenoptera, Lepidoptera, and Orthoptera.

INTRODUCTION

Lizard's tail, *Saururus cernuus* L. (Saururaceae), is a perennial, rhizomatous, herbaceous plant common on hydric soils, typically in shady habitats. It is common throughout the Coastal Plain and Piedmont of Maryland and Virginia (Brown and Brown 1984; Virginia Botanical Associates 2018) and occurs from Canada to Florida, westward to Texas (Buddell and Thieret 1997). The lizard's tail family (Saururaceae) is a small, primitive, plant family containing only six species in the order Piperales (Raju 1961). Only *S. cernuus* and yerba mansa, *Anemopsis californica* (Nutt.) Hook. & Arn., are native to North America; the others are Asian (Buddell and Thieret 1997). *Saururus cernuus* reaches heights of just over 1 m (3.3 ft) and has entire, cordate leaves, the lower ones the largest, generally 15 cm (9 in) long and 10 cm (4 in) wide. Each plant produces one or two terminal, crook-shaped racemes on each branch. The showy, bright white, aromatic inflorescences may be over 20 cm (8 in) long and 1 cm (0.4 in) wide and contain up to 350 small, tightly aggregated flowers with 6 or 8 protruding stamens in two whorls or 3 in a single whorl (Raju 1961). Anthesis proceeds from the base of the racemes to the tip, rendering a gradient of flowering and fruit maturation and a straightening of the inflorescence. In the southern United States, anthesis proceeds at approximately 1.52 cm (0.6 in) per day (Thien et al. 1994). Thien et al. (1994) concluded pollination was primarily insect-mediated or wind-dependent. *Saururus cernuus* propagates both vegetatively and by seed; however, vegetative reproduction may be more important to population persistence since seedlings have not been reported from field studies (Hall 1940, Penfound et al. 1945). Thien et al. (1994) attempted to discern the pollination mode for *S. cernuus* in Louisiana based on observations of potential pollinators and observed

Diptera and Coleoptera feeding on pollen. This study documents the species of Coleoptera and other arthropod orders associated with flowers of a large population of *S. cernuus* in Maryland.

STUDY SITE

The study site at Cove Point, in Calvert County, Maryland, is located at 38°23′30.6″, -76°24′02.2″ in a forested swamp with a canopy of red maple, *Acer rubrum* L. (Sapindaceae), and blackgum, *Nyssa sylvatica* Marshall (Cornaceae). The herb layer is strongly dominated by a crescent-shaped patch of *S. cernuus* (Figure 1) with a maximum length and width of approximately 70 m (230 ft) by 20 m (66 ft). The site is situated near the Chesapeake Bay and is bordered by a non-tidal, freshwater marsh known for its high number of state rare plant species (Steury 1999).

Figure 1: The study site at Cove Point, Calvert County, Maryland on 25 June 2018, showing lizard's tail (*Saururus cernuus* L.) in foreground, under a canopy of red maple (*Acer rubrum* L.) and blackgum (*Nyssa sylvatica* Marshall).

MATERIALS and METHODS

The top was cut from a plastic, 3.8 L (1 gal) milk jug and a thin film of water was added. The jug was held under an *S. cernuus* inflorescence as it was bent into the jug and shaken. The process was conducted for the first 30 minutes of each hour, from 9:00 a.m. to 12:30 p.m. on 21–23 June 2018, and from 11:00 a.m. to 2:30 p.m. on 25 June 2018. The process did not damage the inflorescences other than the abscission of some dehisced anthers from the flowers. Beetles fell to the bottom of the jug and were held by the surface tension of the water. They were removed from the jug by hand and placed in a glass vial containing 95% ethanol. One male and one female (when available) of each species was pinned, labeled, and deposited in the entomology collection at the United States National Museum, Smithsonian Institution, Washington, DC. No observed beetle species eluded capture, and it was noted that inflorescences which on close inspection appeared to contain no beetles, often yielded Coleoptera in the bottom of the jug. Individuals of other arthropod orders captured during the survey were released after being recorded in a field notebook. During each day of the survey, *S. cernuus* flowers at various stages of anthesis were present. No leaves of *S. cernuus* were inserted in the jug and arthropods observed on leaves were not included in the tally. Weather was recorded on 21 June as partly cloudy with a high temperature of 28.9 °C (84 °F) during the survey; 22 June as intermittent light rain and a high temperature of 23.9 °C (75 °F); 23 June as overcast and humid with a high temperature of 27.8 °C (82 °F); and 25 June as mostly sunny with a high temperature of 28.3 °C (83 °F).

RESULTS and DISCUSSION

A total of 646 beetles of 29 species in 14 families were captured from flowers of *S. cernuus* at Cove Point Marsh during eight hours of sampling over four days (Table 1). The most common beetle captured was *Isomira sericea* (Say) (Tenebrionidae) (n = 347). Other common species were *Mordellistena masoni* Liljeblad (n = 146), *Glipostenoda ambusta* (LeConte) (n = 21), *Mordella marginata* Melsheimer (n = 20), and *Falsomordellistena pubescens* (Fabricius) and *Mordellistena liturata* (Melsheimer) (n = 18 each) (all Mordellidae). The families with the highest species richness were Mordellidae (n = 10 species), Cerambycidae (n = 4 species), and Curculionidae (n = 3 species). Families with the highest number of individuals were Tenebrionidae (n = 347), Mordellidae (n = 233), and Cerambycidae (n = 27). Three of four species of Cerambycidae: *Strangalia luteicornis* (Fabricius), *Typocerus lugubris* (Say), and *T. velutinus velutinus* (Olivier), were observed in copula on inflorescences of *S. cernuus*, with the female apparently feeding on pollen during copulation, indicating a possible connection between pollen consumption and mating. One uncaptured and unidentified mordellid that was observed through a 10× hand lens appeared to be feeding on the base of a *S. cernuus* flower ovary, creating a dark scar when finished. Larger beetles (e.g., Cerambycidae and Cantharidae) were observed clinging to the stamens on the exterior edge of the racemes, while smaller beetles (e.g., Mordellidae and *Isomira sericea*) were primarily observed inside the inflorescence along the rachis. The largest beetle captured on flowers of *S. cernuus* was *T. v. velutinus* (17 mm [0.7 in]) and the smallest was *Orthoperus glaber* (LeConte) (Corylophidae) (0.6 mm [0.02 in]). The record of *Lebia*

ornata Say (Carabidae) is the first for Cove Point, increasing the known carabid fauna from the site to 70 species (Steury and Messer 2017).

Based on findings of this study, *S. cernuus* is an important food source for many species of beetles in at least 14 families that may feed upon its pollen and other flower parts. Further study may reveal additional beetle families associated with *S. cernuus*. Other arthropod groups observed on flowers of *S. cernuus* included: Arachnida (Araneae: one spider with a captured wasp and one spider with a captured syrphid fly; and Acari: mites on some beetles), Collembola, Diptera, Hemiptera, Hymenoptera (wasps and ants only), Lepidoptera (larvae, and one adult, dark morph female, Eastern Tiger Swallowtail [*Papilio glaucus* Linnaeus (Papilionidae)]), and Orthoptera. The importance of the large, showy, aromatic inflorescences to a plant that almost exclusively reproduces vegetatively remains unknown.

Table 1: Number of beetles captured on flowers of *Saururus cernuus* L. at Cove Point, Calvert County, Maryland, during two hours of daily search effort on 21–23 June and 25 June 2018. Taxa are listed alphabetically by family, genus, and species.

Family, Genus, Species, and Author	21 June	22 June	23 June	25 June	Total Captured
Anthicidae (antlike flower beetles)					
Macratria murina (Fabricius)	7			3	10
Cantharidae (soldier beetles)					
Chauliognathus marginatus (Fabricius)	4				4
Rhagonycha angulata (Say)	1				1
Carabidae (ground beetles)					
Lebia ornata Say		1			1
Cerambycidae (long-horned beetles)					
Obrium rufulum Gahan	1				1
Strangalia luteicornis (Fabricius)	2	1	3	2	8
Typocerus lugubris (Say)	3				3
Typocerus velutinus velutinus (Olivier)	3		6	6	15
Chrysomelidae (leaf beetles)					
Diabrotica undecimpunctata howardi Barber	3	4	2	2	11
Corylophidae (minute hooded beetles)					
Orthoperus glaber (LeConte)	1			1	2
Curculionidae (true weevils)					
Anthonomus signatus Say			1		1
Geraeus picumnus (Herbst)			1		1
Tyloderma variegatum (Horn)				1	1

Family, Genus, Species, and Author	21 June	22 June	23 June	25 June	Total Captured
Elateridae (click beetles)					
Glyphonyx nanus Smith and Balsbaugh				1	1
Latridiidae (Minute Brown Scavenger Beetles)					
Melanophthalma Motschulsky sp.				1	1
Melyridae (soft-winged flower beetles)					
Hypebaeus oblitus (LeConte)	1				1
Mordellidae (tumbling flower beetles)					
Falsomordellistena hebraica (LeConte)	1				1
Falsomordellistena pubescens (Fabricius)	9	1	2	6	18
Glipostenoda ambusta (LeConte)	6	5	4	6	21
Mordella marginata Melsheimer	5	9	3	3	20
Mordella obliqua LeConte	1				1
Mordellistena fuscata (Melsheimer)			1	1	2
Mordellistena liturata (Melsheimer)	3	3	5	7	18
Mordellistena masoni Liljeblad	54	19	46	27	146
Mordellistena vapida LeConte	1			1	2
Mordellistena vera Liljeblad	2	1		1	4
Scarabaeidae (scarab beetles)					
Valgus canaliculatus (Olivier)	1				1
Scraptiidae (false flower beetles)					
Allopoda lutea (Haldeman)	2			1	3
Tenebrionidae (darkling beetles)					
Isomira sericea (Say)	106	64	82	95	347
Total	**217**	**108**	**156**	**165**	**646**

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Diversity of Sciapodinae (Diptera: Dolichopodidae) in the Greater Washington, District of Columbia Area

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Abstract: Faunal inventories are critical for the conservation of biological resources and diversity. At present, detailed knowledge of Sciapodinae (Diptera: Dolichopodidae) distributions in the Nearctic region is still poorly understood. Herein, I investigate the composition of sciapodine flies in the greater Washington, District of Columbia area. A total of 1657 specimens were identified from the collections of the National Museum of Natural History and the author, representing four genera and 19 species. The most common species, by total occurrences, were *Condylostylus caudatus* (Wiedemann), *C. patibulatus* (Say), and *C. sipho* (Say), which accounted for nearly 83% of all identified flies. The species *Amblypsilopus dorsalis* (Loew), *Condylostylus banksii* (Van Duzee), and *Mesorhaga albiciliata* (Aldrich) are reported for the first time in Maryland. Results presented in this study serve as a baseline for future ecological and biodiversity comparison.

INTRODUCTION

Detailed knowledge of the biota of any site or region is critical for community characterization and environmental impact studies, and is an initial step for biological and natural resource conservation planning (Longino and Colwell 1997, Hughes et al. 2000, Green et al. 2009). Since the early 20th century, there has been considerable interest in the biodiversity of the greater Washington, District of Columbia (DC) area, much of it investigated by members of the Washington Biologists' Field Club (Banks et al. 1916, Alexander and McAtee 1920, McAtee 1921, Malloch et al. 1931, Perry 2007). Although there are more recent studies focused on the biological diversity of insects from the Potomac Gorge (Mathis and Foster 2007, Brown and Bahr 2008, Evans 2008), inventories of the biota of the greater Washington, DC area are still limited for many taxonomic groups.

The Sciapodinae are one of the 14 recognized Nearctic subfamilies in the family Dolichopodidae (Insecta: Diptera) and are comprised of metallic-colored flies usually characterized by a deeply excavated vertex and a widely diverging branch of vein M (Robinson 1964). In the Nearctic region north of Mexico, the subfamily is represented by four genera and 71 species (Pollet et al. 2004) with adults abundant in sunny and moist habitats (Bickel 1994). Generally, adults and larvae of Dolichopodidae are predaceous, occupying an important position in most terrestrial ecosystems. In addition, members of the family have shown promise as biological indicators of environmental quality for conservation purposes (Pollet and Grootaert 1991, 1996; Pollet 2001; Pollet et al. 2003).

Despite these important traits, the Sciapodinae of the greater Washington, DC area have received little attention. Overall, the sciapodine distributions in the Nearctic region are still poorly understood. Our current knowledge of the sciapodine species composition of the greater Washington, DC area is drawn largely from Robinson's (1960, 1964) review of the dolichopodid flies of the southeastern United States in which he provided state records but limited information on local distributions. In addition, two biodiversity publications have listed taxa collected from the Potomac Gorge (Brown 2008, Evans 2008). The present study aims to provide an updated inventory of the Sciapodinae of the greater Washington, DC area that may serve as a baseline for future biodiversity comparison.

METHODS

A list of sciapodine species of the greater Washington, DC area was generated based on an examination of specimens in the collection of the National Museum of Natural History (USNM), Washington, DC, USA, which is known to have significant holdings from the study area, augmented by collections of the author. Flies were identified to species using Van Duzee (1915), Curran (1942), Robinson (1960, 1964), Steyskal (1966, 1973), and other reference material. Voucher specimens from the author are deposited at USNM.

The geographic scope of the greater Washington, DC area is defined for the purpose of this faunal paper as the surrounding area approximately 65 km (40 mi) from the center of Washington, DC. A collections locality map was produced using SimpleMappr software (Shorthouse 2010). Latitude and longitude coordinates were recorded from specimen labels. If coordinates were unavailable, latitude and longitude were estimated from maps to determine the geographical coordinates. Collection sites included the Chesapeake and Ohio Canal Natural Historical Park (MD), Difficult Run (VA), Great Falls Park (VA), Four Mile Run Park (VA), Holmes Run Scenic Easement (VA), Plummers Island (MD), Kenilworth Park and Aquatic Gardens (DC), and Rock Creek Park (DC), in addition to other natural and residential areas.

RESULTS and DISCUSSION

A total of 1657 specimens of sciapodine flies were identified from this region comprising 19 species in four genera (Table 1), representing 27% of the total Nearctic Sciapodinae diversity. The sciapodine species richness in the greater Washington, DC area was estimated using the nonparametric Chao-2 method in the program EstimateS, Version 9.1.0 (Chao 1987, Colwell 2016). Chao-2 provided an estimate of 19.25 sciapodine species for the region [the observed number of species (S_{obs}) is 19, the number of unique collections (Q_1) is 2, and the number of duplicates (Q_2) is 3]. The 95% confidence interval on the richness estimate ranged from 19.01 to 23.78 species. While the Chao-2 result of 19.25 versus the observed 19 species indicates a reasonably complete sampling of the region, the confidence interval of 19.01 to 23.78 species suggests there may be additional taxa.

Based on label data, there were 342 individual collection events. Approximately 73% (n = 1208) of the specimens were collected by Malaise trap; 5% (n = 87) by black light or

light trap; 2% (n = 28) by yellow pan trap; 1% (n = 9) by hand collecting; and 20% (n = 325) by unknown method. The distribution of all collection localities in the greater Washington, DC area is shown in Figure 1. Flies were recorded from 64 sites, including 52% (n = 33) from Maryland, 34% (n = 22) from Virginia, and 14% (n = 9) from Washington, DC. Figure 1 displays just the collection records in and around the study area; species recorded here are found throughout the eastern United States and not necessarily restricted to the Washington, DC area.

Table 1. Species of Sciapodinae (Diptera: Dolichopodidae) from the greater Washington, DC area.

Genera/Species	District of Columbia	Maryland	Virginia	Total Number of Flies Identified
***AMBLYPSILOPUS* Bigot**				
Amblypsilopus dorsalis (Loew)	1	**1***		2
Amblypsilopus scintillans (Loew)	1	32	3	36
Amblypsilopus unicoiensis (Robinson)			11	11
Amblypsilopus unifasciatus (Say)		4		4
***CONDYLOSTYLUS* Bigot**				
Condylostylus banksii (Van Duzee)		**3***	5	8
Condylostylus calcaratus (Loew)		13	5	18
Condylostylus caudatus (Wiedemann)	8	117	928	1053
Condylostylus comatus (Loew)	9	23	17	49
Condylostylus flavipes (Aldrich)		5		5
Condylostylus inermis (Loew)	2	1		3
Condylostylus nigrofemoratus (Walker)	1	26	33	60
Condylostylus patibulatus (Say)	5	41	136	182
Condylostylus scaber (Loew)		12	12	24
Condylostylus sipho (Say)	5	47	84	136
Condylostylus viridicoxa (Aldrich)	3	6	28	37
***MESORHAGA* Schiner**				
Mesorhaga albiciliata (Aldrich)		**1***		1
***SCIAPUS* Zeller**				
Sciapus filipes (Loew)		4	20	24
Sciapus pallens (Wiedemann)	1			1
Sciapus tener (Loew)		2	1	3
Total Number of Flies Identified	36	338	1283	1657
Total Number of Species	10	17	13	19

***New state record.**

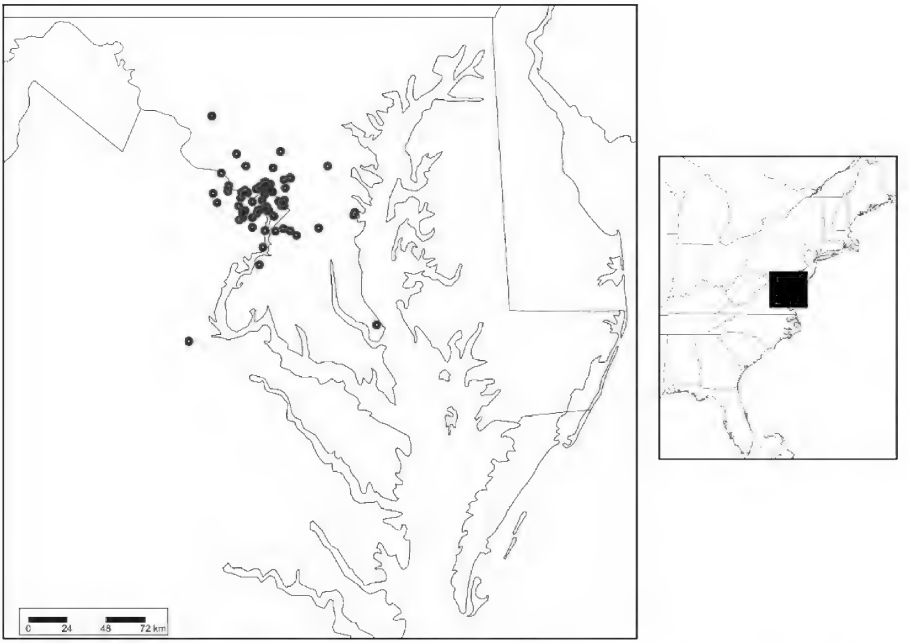

Figure 1. Map of the greater Washington, DC area displaying distribution of collection records of Sciapodinae (Diptera: Dolichopodidae), with eastern USA (inset). The map was generated using SimpleMappr software (Shorthouse 2010) applying the World Mercator map projection. The presented map displays just the collection records in and around the greater Washington, DC area.

There was considerable overlap of species recorded during the present study compared with previously published records (Robinson 1960, 1964; Brown 2008; Evans 2008). All taxa previously recorded from the Washington, DC area were recorded in the present inventory. Herein, the species *Amblypsilopus dorsalis* (Loew) and *Condylostylus banksii* (Van Duzee) are reported for the first time in Maryland (Table 1, Figure 2). Robinson (1960) recorded *A. dorsalis* from Rock Creek Park in Washington, DC and its known distribution ranges south into Florida and the Neotropics (Pollet et al. 2004). Presently, few localities exist for *C. banksii*; it is currently reported from Falls Church, Virginia, in addition to Massachusetts and New York (Pollet et al. 2004). Also notable was the presence of *Mesorhaga albiciliata* (Aldrich) (Table 1, Figure 2) in Maryland, which is only known from Georgia, New Jersey, and North Carolina (Robinson 1964, Pollet et al. 2004).

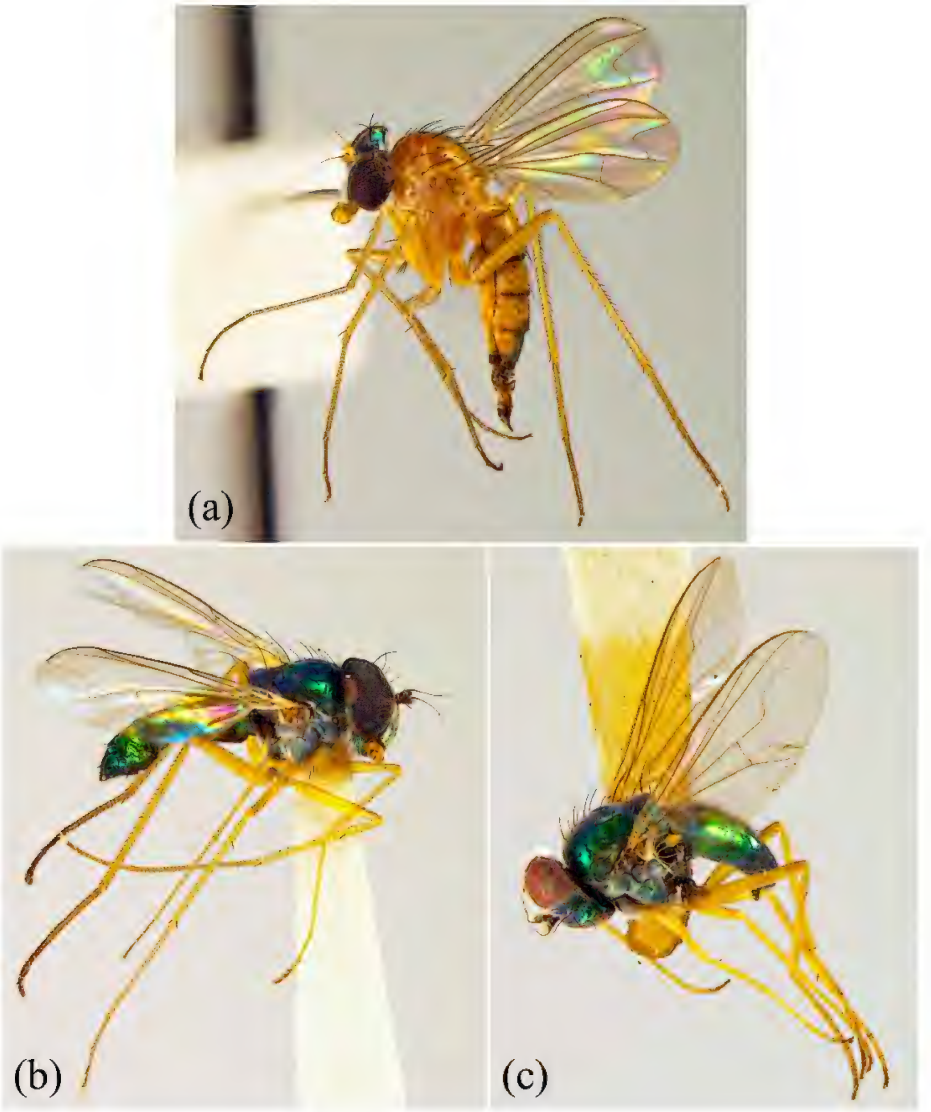

Figure 2. Sciapodinae species new to Maryland. (a) *Amblypsilopus dorsalis* (Loew), lateral view of female; (b) *Condylostylus banksii* (Van Duzee), lateral view of male; (c) *Mesorhaga albiciliata* (Aldrich), lateral view of female. Photographed by Gary D. Ouellette.

The most commonly collected sciapodine species in this geographic area, by total occurrences, included *Condylostylus caudatus* (Wiedemann) (64% of all specimens, n = 1053), *C. patibulatus* (Say) (11%, n = 182), and *C. sipho* (Say) (8%, n = 136), which collectively comprised approximately 83% (n = 1371) of all identified specimens. All three species are common and widely distributed throughout much of North America (Curran 1942, Pollet et al. 2004). Overall, the genus *Condylostylus* Bigot represented 95% (n = 1575) of all identified sciapodine specimens. However, this large, diverse genus is complex and the taxonomy of a few of the recorded species are questionable (Robinson 1964). Both *C. calcaratus* (Loew) and *C. inermis* (Loew) are considered variants of *C. nigrofemoratus* (Walker) that differ only in male secondary features and probably do not represent true species (Robinson, in litt., 4 May 2019).

Robinson (in litt.) further elaborated that dolichopodids are much rarer in the area than they were in the past as a possible result of pesticide spraying and other human alterations to the environment.

Although it is possible that some sciapodine species were not represented in the samples examined, the present investigation serves as baseline to support future ecological and biodiversity studies for the greater Washington, DC area and surrounding environs.

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The Maryland Entomologist 7(3):23–27

Yellow-banded Bumble Bee, *Bombus terricola* Kirby (Hymenoptera: Apidae), Found in West Virginia

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In eastern North America, several bumble bee species (Hymenoptera: Apidae: *Bombus* Latreille spp.) have declined (Colla and Parker 2008; Evans et al. 2008; Grixti et al. 2009; Cameron et al. 2011, 2016; Schweitzer et al. 2012; Williams et al. 2014). One of those in decline is the Yellow-banded Bumble Bee, *Bombus terricola* Kirby (Figure 1) (Evans et al. 2008, Cameron et al. 2011, Jacobson et al. 2018). In 2018, a survey of West Virginia (WV) native bee species was initiated to determine status and distributions throughout the state. Collectors for the survey utilized Trimble Geo 7X sub-meter accuracy GPS units with customized data input to document survey locations, habitat, and other resources available at the time of surveys. Past collection records indicated that the Yellow-banded Bumble Bee was historically present within WV. The Yellow-banded Bumble Bee was previously documented in Pocahontas County in 1958, 1960, and 1972, and Pendleton County in 1960 and 1979 (Milliron 1971, McKinney 2016, Ascher and Pickering 2018, Various Contributors 2019).

Williams et al. (2014) indicate various characters for identifying the Yellow-banded Bumble Bee and for distinguishing it from other bumble bee species. The Yellow-banded Bumble Bee has short, even hair; a short head with an oculo-malar area (cheek) barely shorter than broad (differing from *Bombus pensylvanicus* (De Geer), *B. auricomus* (Robertson), *B. nevadensis* Cresson); the midleg basitarsus with a rounded rear angle; and the flat outer surface of the hindleg tibia without long hair but having long fringes along the sides forming a corbicula. The hair on the head is black or with a minimal number of short pale hairs intermixed; the base of T2 is usually yellow without black or with only a narrow fringe along the basal margin; if T2 is more extensively black, then T4–5 are also mostly black (differing from *B. occidentalis* Greene). T3 is usually yellow and T5 is black or yellow-brown (differing from most *B. cryptarum* (Fabricius). The wings are slightly brown (differing from *B. cryptarum*) (Williams et al. 2014). The Yellow-banded Bumble Bee has a more constant color pattern as compared to other bumble bees but has a marked chromatic variation, particularly between specimens collected from the southeastern and northwestern areas of its range (Milliron 1971).

During the 2018 WV native bee survey, nine Yellow-banded Bumble Bees were found at eight locations from 14 July to 27 August. Seven females and two males were found during surveys within Pendleton, Pocahontas, Randolph, and Tucker Counties (Table 1, Figure 2). Eight of the individuals were either not specifically seen during capture or misidentified in the field. A queen captured on 27 August was field identified, photographed, and released. Table 1 lists the floral resource from which bees were

Figure 1. Female Yellow-banded Bumble Bee (*Bombus terricola* Kirby). Top: lateral view; bottom: posterior view. Collected with a hand net during a 10-minute roadside survey in Pocahontas County, West Virginia on 11 August 2018. Photographed by Mark J. Hepner.

collected during these surveys. These floral resources included sunflower, *Helianthus* L. spp.; goldenrod, *Solidago* L. spp.; thistle, *Cirsium* Mill. spp.; and wingstem, *Verbesina alternifolia* (L.) Britton ex Kearney (all Asteraceae). The most northern and most southern survey locations were 116 km (72 mi) apart, averaging a distance of 16 km (10 mi) between individual collection locations. All *B. terricola* specimens collected were in high-elevation habitat of WV (Byers et al. 2007), averaging 1,200 m (3,937 ft) above sea level and all *B. terricola* specimens were collected within the United States Department of Agriculture (USDA) United States Forest Service's (USFS) Monongahela National Forest. The 2018 records represent the first *B. terricola* to be found in WV since 1979 (Ascher and Pickering 2018; United States Fish and Wildlife Service, in litt.). Bee identification was validated by Sam Droege at the United States Geological Survey (USGS) Patuxent Wildlife Research Center's (PWRC) Bee Inventory and Monitoring Lab (BIML) in Laurel, Maryland.

Table 1: 2018 West Virginia Yellow-banded Bumble Bee locations.

Date Collected	County	Number Collected	Sex	Elevation - m (ft)	Latitude	Longitude	Habitat	Floral Resource
14 JUL 2018	Pocahontas	1	F	1,382 (4,534)	38.2686	-80.2393	early-successional, roadside	*Erigeron strigosus* Muhl. ex Willd., *Securigera varia* (L.) Lassen
10 AUG 2018	Pocahontas	1	F	860 (2,822)	38.3893	-80.1293	early-successional, roadside	*Verbesina alternifolia* (L.) Britton ex Kearney
11 AUG 2018	Pocahontas	2	F	1,361 (4,465)	38.5146	-79.9116	early-successional, roadside	*Eutrochium purpureum* (L.) E.E. Lamont, *Prunella vulgaris* L.
11 AUG 2018	Pendleton	1	M	1,193 (3,914)	38.6462	-79.6270	early-successional, roadside	*Asclepias syriaca* L., *Silphium perfoliatum* L., *Ratibida pinnata* (Vent.) Barnhart
11 AUG 2018	Pendleton	1	M	1,423 (4,669)	38.6925	-79.5431	early-successional, roadside	*Centaurea stoebe* L. ssp. *micranthos* (Gugler) Hayek, *Cirsium* Mill. spp.
21 AUG 2018	Randolph	1	F	1,207 (3,960)	38.7374	-79.6018	early-successional, field	*Helianthus* L. spp.
26 AUG 2018	Tucker	1	F	1,169 (3,835)	38.9679	-79.3447	early-successional, roadside	*Cirsium* Mill. spp., *Monarda fistulosa* L., *Solidago* L. spp.
27 AUG 2018	Tucker	1	F	1,002 (3,287)	39.0160	-79.3194	early-successional, roadside	*Solidago* L. spp.

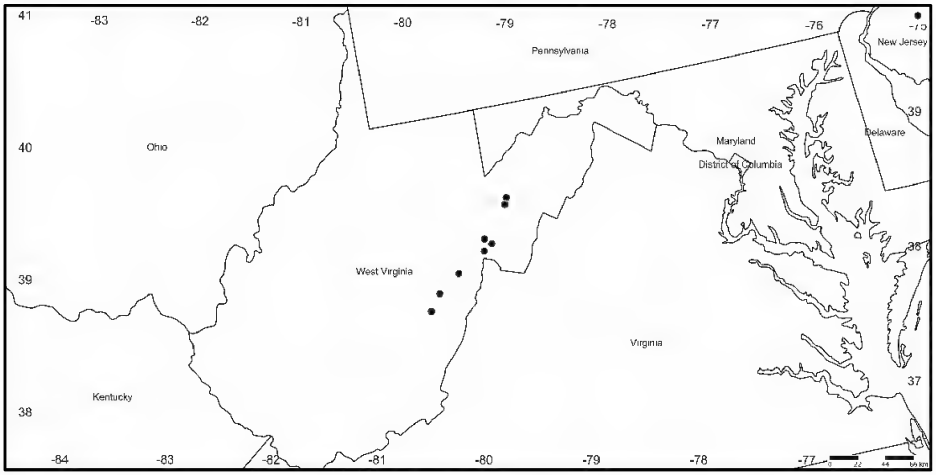

Figure 2. West Virginia Yellow-banded Bumble Bee locations, 14 July–27 August 2018. Nine records, eight locations. Created with SimpleMappr (Shorthouse 2010).

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Bumble Bees, *Bombus* Latreille (Hymenoptera: Apidae), in State Wildlife Action Plans: New Opportunities for Conservation

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Abstract: We report significant growth in interest and available resources for the conservation of bumble bees, *Bombus* Latreille (Hymenoptera: Apidae), in the USA, as measured by the inclusion of these species in the 56 U.S. State Wildlife Action Plans. In the first editions of these plans, completed in 2005, only three states included a total of three species of the genus *Bombus* in their plans. In the second editions of these plans, completed in 2015–2016, 26 states and the District of Columbia included 25 species of the genus *Bombus* in their plans as "Species of Greatest Conservation Need." The species most frequently identified by states as "Species of Greatest Conservation Need" included *Bombus affinis* Cresson (17 states and the District of Columbia), *B. pensylvanicus* (De Geer) (17 states), *B. terricola* Kirby (15 states), and *B. fervidus* (Fabricius) (11 states). A complete list of the *Bombus* species included in these plans and a map showing the associated states are provided. Inclusion of these species in these plans will increase the available funding for bumble bee conservation and provide new opportunities for interstate and regional partnerships to conserve these species.

Keywords: Apidae, Apoidea, *Bombus*, bumble bee, conservation, Hymenoptera, pollinator

Significant declines have been reported in populations of many North American species of bumble bees, *Bombus* Latreille (Hymenoptera: Apidae; Figure 1) (Brown 2011, Cameron et al. 2011, The Xerces Society for Invertebrate Conservation 2019), and multiple species in this genus have been formally proposed for listing under the U.S. Endangered Species Act (The Xerces Society for Invertebrate Conservation 2010, 2013). Reports of bumble bee population declines in the USA have generated considerable interest among conservation biologists (Brown 2011) and wildlife managers (Learn 2016). Here we document the growth of interest and enhanced opportunities for bumble

bee conservation in the USA between 2005 and 2016, as reflected by increased inclusion of *Bombus* species in the 56 U.S. State Wildlife Action Plans.

Figure 1: *Bombus auricomus* (Robertson) visiting wild bergamot, *Monarda fistulosa* L. (Lamiaceae), on the National Mall in Washington, DC, USA. This bumble bee species has been identified as a "Species of Greatest Conservation Need" in Delaware and Maryland.

The State Wildlife Action Plans (SWAPs) are documents that describe approaches for the conservation of wildlife species and ecological communities in each of the 50 U.S. states, the District of Columbia, and five U.S. territories (Riexinger and Williamson 2009, Stoms et al. 2010, Meretsky et al. 2012). Under the U.S. federal system, the governments of these individual states and territories have legal responsibility for managing much of the nation's biodiversity, including many of the animal pollinator species which are not listed under the federal Endangered Species Act (Association of Fish & Wildlife Agencies 2012, The Heinz Center 2013, Mawdsley et al. 2016).

Each of the 56 SWAPs is intended to present a comprehensive blueprint for the conservation of aquatic and terrestrial biodiversity within a particular state or territory. Each plan, developed in collaboration with multiple conservation partners, contains a set of common elements: a list of species of conservation interest, called "Species of Greatest Conservation Need" (SGCN); descriptions of the habitats occupied by these wildlife species; descriptions of threats to species and their habitats; identification of monitoring approaches, including both status and effectiveness measures; provisions for public engagement; and provisions for review and revision of the plans (Riexinger and Williamson 2009, Stoms et al. 2010, Fontaine 2011, Meretsky et al. 2012). The first set of SWAPs was completed in 2005 (Association of Fish & Wildlife Agencies 2012), and a

second, revised, set of plans has now been completed by states and territories and published online in 2015–2016 (Mawdsley et al. 2016).

Although pollinators were not specifically identified as a priority for inclusion in the original SWAPs, many states did include taxa from insect pollinator groups in their first plans. According to an analysis and review published by The Heinz Center (2013), 127 species of butterflies (Lepidoptera: Papilionoidea) and 103 species of skippers (Lepidoptera: Hesperioidea) were mentioned in 40 of the 56 original plans; 24 plans mentioned one or more native moth species (Lepidoptera); 11 plans included flies (Diptera); and 10 plans mentioned social or solitary bees (Hymenoptera: Apoidea), including a total of 31 bee taxa. Three states (Alaska, California, and Illinois) included three species of the genus *Bombus* as SGCN (*Bombus franklini* (Frison), *B. fraternus* (Smith) and *B. occidentalis* Greene) in their original State Wildlife Action Plans (The Heinz Center 2013, Mawdsley and Humpert 2016).

A revised set of SWAPs was prepared and released by the individual U.S. state fish and wildlife agencies in 2015–2016 (Mawdsley et al. 2016). Preliminary data collected from state wildlife agency staff before the final completion of these plans indicated that many of the revised plans were likely to include bumble bees and other pollinator taxa as SGCN (Mawdsley and Humpert 2016). Because these plans are directly associated with dedicated funding from federal and regional grants programs, the inclusion of species of the genus *Bombus* in these plans will create important new opportunities for bumble bee conservation efforts in North America.

METHODS

Staff from the Association of Fish & Wildlife Agencies conducted annual or semi-annual web-based surveys of the 56 SWAP coordinators between 2013 and 2016, in order to learn more about the progress of the individual plan revisions, as well as the plant and animal taxa that were likely going to be included in the revised plans. The online "Survey Monkey" platform (www.surveymonkey.com) was used to collect this information from the SWAP coordinators. Surveys conducted in May 2015 and May 2016 specifically asked about the possible inclusion in the revised plans of representatives from animal taxa that included known or likely pollinator species. The May 2015 survey asked states and territories whether they were planning to include native bees (Hymenoptera: Apoidea) in their revised plans, while the May 2016 survey asked specifically whether the individual states and territories were including bumble bees, *Bombus* spp., in the revised plans. In four cases of non-response to this question (i.e., either the state representative did not complete the survey, or left the question about bumble bees blank), the authors followed up directly with the SWAP coordinator in the non-responsive state in order to obtain information about the inclusion of bumble bees in the revised plan.

For those states that had indicated in the surveys that they would be including bumble bees in their revised plans, the authors then reviewed final copies of their revised plan documents in 2016 as posted on official state government websites (links to all 56 plans are available at: https://www.fishwildlife.org/afwa-informs/state-wildlife-action-plans). For each plan, the authors downloaded the relevant portion(s) of the document which

contained the lists of SGCN in .pdf or .docx or .xlsx formats. The authors then performed a comprehensive word search for the following strings of text characters: "bumble," "bumblebee," "bee," and "*Bombus*." All species of *Bombus* that had been included as SGCN in the revised plans were then listed in a Microsoft Excel spreadsheet, along with a comprehensive list of the individual states that had included each of these species as SGCN.

RESULTS

Twenty-seven of the revised SWAP documents included at least one species of the genus *Bombus* as an SGCN. One additional state (Colorado) did not include bumble bees as SGCN, but did mention The Xerces Society for Invertebrate Conservation and collaborators' "Bumble Bee Watch" citizen science program (www.bumblebeewatch.org) in the revised plan's chapter on monitoring of wildlife species. Twenty-five species of *Bombus* were included in total across all of the revised plans. Lists of these species with the associated states are presented in Table 1. Species most frequently identified by states as SGCN included *Bombus affinis* Cresson (17 states and the District of Columbia), *B. pensylvanicus* (De Geer) (17 states), *B. terricola* Kirby (15 states), and *B. fervidus* (Fabricius) (11 states).

Table 1: *Bombus* Latreille species included in the 2015–2016 revised U.S. State Wildlife Action Plans. States are designated by their postal abbreviations.

Species	States including the species as a "Species of Greatest Conservation Need"
B. affinis Cresson	CT, DC, DE, GA, MA, MD, ME, MI, MN, NC, NH, NJ, NY, PA, RI, VA, VT, WI
B. ashtoni (Cresson)	CT, DE, MD, ME, NJ, NY, PA, VT
B. auricomus (Robertson)	DE, MD
B. bohemicus (Seidl)	MN, VA
B. borealis Kirby	GA, NY
B. citrinus (Smith)	MD, ME, VT
B. fernaldae (Franklin)	ME, VT
B. fervidus (Fabricius)	ID, MA, ME, MN, NC, NH, NJ, NY, VA, VT, WI
B. franklini (Frison)	CA, OR
B. fraternus (Smith)	DE, IL, NC, NJ, OK, VA
B. frigidus Smith	WI
B. griseocollis (De Geer)	ME
B. huntii Greene	ID
B. insularis (Smith)	ID, WA
B. morrisoni Cresson	ID, WA
B. occidentalis Greene	AK, CA, ID, OR, WA
B. pensylvanicus (De Geer)	CT, DE, ID, LA, MA, MD, ME, MN, NC, NH, NJ, NY, OK, TX, VA, VT, WI
B. perplexus Cresson	VT, WI
B. rufocinctus Cresson	VT
B. sandersoni Franklin	MD, ME, NJ, WI
B. sonorus Say	TX
B. suckleyi Greene	ID, WA
B. terricola Kirby	CT, MA, MD, ME, MI, MN, NC, NH, NJ, NY, PA, RI, VA, VT, WI
B. vagans Smith	DE, MD, NC
B. variabilis (Cresson)	DE, MD, NC, NJ, TX, VA

Figure 2 shows states with at least one species of Bombus in their revised SWAP. As can be seen from Figure 2, these states include much of the northeastern United States, the entire west coast, and separate clusters of states in the upper Midwest and lower central portion of the country.

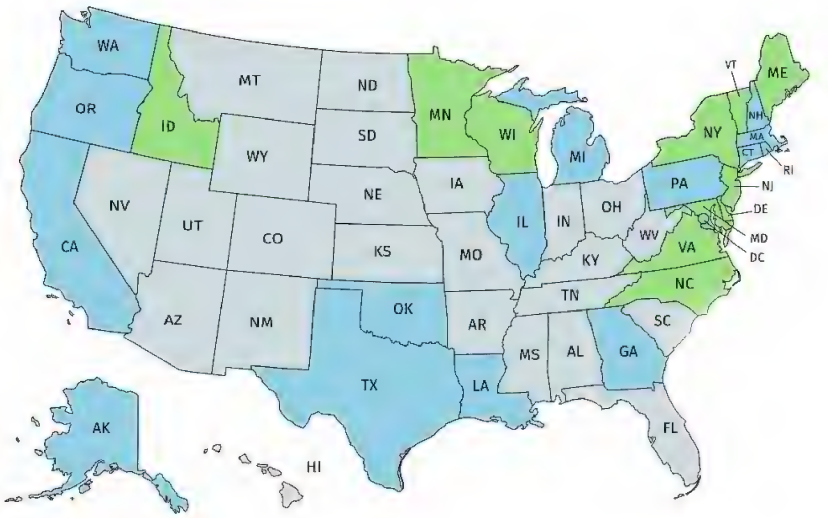

Figure 2: Map of the United States showing states with species of the genus *Bombus* as "Species of Greatest Conservation Need" (SGCN) in their most recent State Wildlife Action Plan (SWAP). States in blue have one to four species; states in green have five or more species.

The percentage increase in the number of bumble bee species included in the revised SWAPs is at least an order of magnitude greater than the increases observed in other groups of organisms. Overall, the number of bumble bee species included in the SWAPs increased from three in 2005 to 25 in 2015–2016, a percentage increase of 733%. The total number of taxa included in all 56 plans increased from 12,363 in 2005 to 17,200 in 2015–2016, a percentage increase of 39%, while the total number of insect taxa increased from 2,488 to 3,516, a percentage increase of 41% (United States Geological Survey 2019). Looking at other invertebrate groups, the number of mollusk taxa increased from 1,223 to 1,342, a percentage increase of 10%, while the number of crustacean taxa decreased from 842 to 746, a decrease of 11% (United States Geological Survey 2019).

DISCUSSION

The SWAPs are closely linked to important funding sources for wildlife conservation in the United States, particularly the State and Tribal Wildlife Grants Program which is administered by the U.S. Fish and Wildlife Service (Association of Fish & Wildlife Agencies 2011, 2012). This grant program provides each state with annual funding for the conservation of those wildlife species that are not the subject of active hunting or trapping programs (the so-called "non-game" species). Each state receives a direct apportionment of funding from this program each year, and funds are also available for competitive grant proposals to support projects that benefit multiple states. The financial support from this program is intended to benefit the conservation of species which are included as SGCN in the SWAPs (Association of Fish & Wildlife Agencies 2011, 2012).

By including bumble bees as SGCN in their revised SWAPs, 26 states and the District of Columbia now have expanded opportunities to conduct conservation activities to benefit these species. One of the most important sources of financial support for these conservation activities is the State and Tribal Wildlife Grants Program, which has contributed over one billion US$ towards the conservation of SGCN and their habitats since the program's inception in the year 2000 (Association of Fish & Wildlife Agencies 2012). Activities that could potentially be funded through these grants program include surveys and monitoring for rare bumble bee species, status reviews and the development of conservation plans for individual species or groups of species, and projects to restore and enhance bumble bee habitats. In addition, multiple states could work together to develop broader, cross-boundary conservation strategies for rare and declining bumble bee species using dedicated funding available through the competitive portion of the State and Tribal Wildlife Grants Program. Finally, funding may also be available to conserve these species from other grant programs, such as the Northeast Association of Fish and Wildlife Agencies' Regional Conservation Needs Grant Program (Northeast Fish and Wildlife Diversity Technical Committee 2015). Together, these resources offer significantly expanded opportunities for bumble bee conservation in the United States.

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We thank the Wildlife Diversity Program Managers and State Wildlife Action Plan Coordinators in the 56 U.S. state and territorial fish and wildlife agencies for providing us with information about the inclusion of pollinator taxa (including bumble bees) in the revised U.S. State Wildlife Action Plans. We are especially grateful to Chris Burkett (Virginia Department of Game and Inland Fisheries), Jenny Dickson (Connecticut Bureau of Natural Resources), John Kanter (New Hampshire Department of Fish and Game), Eric Odell (Colorado Parks and Wildlife), and Mary Pfaffko (Georgia Wildlife Resources Division) for discussions that greatly improved our understanding of state conservation efforts to benefit pollinating insects. For help with the original review of the individual State Wildlife Action Plans, we thank Leslie Corcelli, Martha Surridge, and Kathryn Wallace of The Heinz Center, as well as Abigail L. Benson of the U.S. Geological Survey. We thank Sam Droege of the U.S. Geological Survey for review of the manuscript prior to publication.

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COVER PHOTOGRAPH

Yellow-banded Bumble Bee, *Bombus terricola* Kirby (Hymenoptera: Apidae) on common milkweed, *Asclepias syriaca* L. (Asclepiadaceae). Photographed in the Monongahela National Forest, Pendleton County, West Virginia, 25 July 2019.

Photographed by Mark J. Hepner